sea are not always proofs of subsidence. Such valleys, like coral reefs, may owe their existence to different factors in different cases.

The harbours of this coast are the high parts of submarine fault valleys, and the portion bordered by land is often only a small part of the whole. Yet the evidence is very clear that the coast has risen regularly since the Red Sea was made, and that river erosion has had nothing to do with the formation of these steep-sided rifts. The coast of equatorial East Africa is essentially similar, though there the fault features are not so obvious, as they have been smoothed down somewhat by the heavy rainfall. Yet such harbours as Mombasa, Kilindini, Tanga, and Wasin are obviously homologous with those of Port Sudan, Suakin, and the desert harbours of the Red Sea.

Chwaka Bay, on the east coast of Zanzibar, is part of a depression which runs right across the island in a south-west direction, and forms long inlets where it reaches the sea on the other side.

The island of Pemba, a little north of Zanzibar, is dissected in a wonderful way on its west side by long fiords running far into the land, and ending in mangrove creeks, perfect slaver- and pirate-hiding places. The land is comparatively high and of great fertility, so that a coasting voyage among the fiords is one of great pleasure and interest.

Surely these are typical drowned valleys? Not at all; the island, like Zanzibar, was elevated in late Tertiary times, the fossils of its coral cliffs are Pleistocene or recent, and both islands have remained at or near their present level while their reefs were carved out. In places on the east coast of Zanzibar the reef is up to three miles wide, and is something between a fringing and a barrier formation. Yet it was all formed by abrasion of elevated coral land.

Along the edge of the deep water, in a line at right angles to the Pemba fiords, is a regular but broken line of reefs and islands, a typical barrier. Where the islands have not been worn away by the sea they are formed entirely of elevated coral, and the reefs have been formed by abrasion of land. When this process is complete, there will be a typical barrier reef, should the islands continue stationary at the level to which they were originally elevated.

The two islands, Zanzibar and Pemba, were originally regular oval cups of coral (or perhaps saucers rather, as in Pemba coral limestone is seen at lowest tide level a long way up Chaki Chaki Bay), and were connected with the mainland. These were filled with the sand and pebbles which now form most of the hills. After elevation they were cut off from the mainland by marine erosion, possibly (in the case of Pemba at least) also by a comparatively deep fault. Other faults on this side cracked the saucers, and irregularity was further induced by marine abrasion, in some places made excessive by powerful silt-bearing currents, in others neutralised by the protection afforded by growing coral and algæ. As along the deep water conditions more uniformly favour the growth of protecting organisms, the edges of the saucers retain their regularity, while within the mass of sand and the limestone on which it lies is subject to rapid degradation. The fiords are extending into the land among the mangrove swamps at their heads. The roots of the mangroves penetrate the crevices of the coral and cause shallow accumulations of mud, both factors for the disintegration and solution of coral limestone. I take the extremely complicated outline of the south end of Pemba Island to be an example of the barachois described by Prof. Gardiner in the results of the Percy Sladen Trust expedition to the western Indian Ocean.

In the Red Sea the heads of the harbours are being filled in with blown sand and flood-borne alluvium, but in Pemba there are no delta-like formations; the marine currents are far too powerful to allow of them, even if the streams were big enough to convey any quantity of alluvium.

In the Red Sea and equatorial East Africa we thus have, on stationary or rising coasts:—(1) Submarine valleys which are scarcely altered from the original fault rifts; (2) those of similar origin somewhat disguised by the effects of tidal currents and fresh-water streams.

The above have little if any continuation into the land, but in Pemba are found:—(3) Long fiords simulating drowned valleys, but of the same origin as (1) and (2); (4) barrier reefs formed by abrasion alone, in Zanzibar and Pemba.

In the Red Sea are (5) barriers which are features of the sides of a rift valley merely coated with coral.

(6) The barriers of the equatorial coast may be of the same origin as those of the Red Sea, but, if Zanzibar Island be reckoned a part of this barrier, removal of the intervening land has been at least the cause of the final separation, as proved by the fauna of the island. Probably they are comparable to the barrier of the west side of Pemba in structure and origin, due to the faulting and erosion of the heterogeneous material of coral deposits.

My statements here are dogmatic for want of space, but details are given in my papers in Proc. Camb. Phil. Soc., 1902, and Journ. Linn. Soc., vol. xxxi., 1907 and 1911.

My being in a distant and isolated village, which is, however, a few yards from coral reefs, is my excuse for the delay in your receipt of this contribution to the discussion. CYRIL CROSSLAND.

Dongonab, Red Sea, February 24.

Elliptical Lunar Halos.

ON the morning of January 26, 1908, while observing with the Keeler reflector of this observatory, I noticed a curious lunar halo, which I described as follows in the notes made at the time:—

"At 4.25 a.m. (Eastern standard time) I saw an elliptical halo close to and concentric with the moon. Its major axis was vertical, and was about 7° long, the lunar diameter being used to make this estimate. The horizontal axis was a little less than half the vertical, or about 3°. The halo lasted only about one minute, but was unmistakable, being well defined (except near the bottom) on both its inner and outer edges. It reappeared less distinctly at 4.31 a.m., lasting only a few seconds. I watched the moon until 4.50 a.m., but saw no third appearance. The halo was white in colour. There was a light east wind blowing at the time, and there was a little haze in the sky. The temperature was 28° F., and had been very constant all night. The moon was at last quarter."

At my request the other observers here have watched for such a halo, and on December 1, 1908, both Prof. Jordan and Dr. Baker witnessed a much longer appearance of it. Prof. Jordan's notes read as follows:—

"An elliptical lunar halo was visible here on the evening of December 1, 1908. The night began with a very clear sky, but about eight o'clock a slight haze became visible in the neighbourhood of the moon. This soon began to take definite form, and the halo developed. It remained visible until about 9 p.m., when it gradually disappeared and the sky soon became cloudy. The halo varied greatly in brightness because of the varying amount of haze in the atmosphere: very

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definite and bright when the amount was large, and occasionally disappearing in part or even completely as the atmosphere cleared. Sometimes the whole halo became uniformly faint, while at other times portions of the circumference disappeared. The major axis was vertical, the moon being about on the meridian. The axes were estimated to be about 7° and 4° respectively, but no careful measures were made. The colour, if any, was very slight. The moon was at first quarter."

None of my astronomical friends to whom I have described these elliptical halos has ever seen one. They must be rare phenomena, and well worth recording.

Frank Schlesinger.

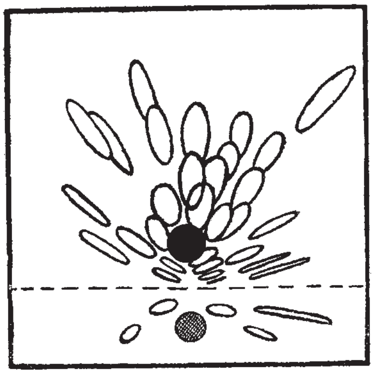
Allegheny Observatory, February 24.

The halo appears to be that known as "Hall's halo," but the diameters given are rather less than those observed by Hall. The phenomenon is mentioned in Pernter's "Meteorologische Optik" (p. 262), and an explanation is suggested by him on p. 381 of that work. [Ed. Nature.]

The Reflection of X-Rays.

In continuation of the experiments of Mr. W. L. Bragg (Nature, December 12, 1912, p. 410), I have investigated the reflection of X-rays by mica. Mr. Bragg finds one reflected beam, while Messrs. Hupka and Steinhaus (Nature, March 6, 1913, p. 10) find two beams. Using a parallel pencil and an angle of incidence of 70°, I find no difficulty in photographing five beams emerging from the "incident" side of the mica, of which that obeying the ordinary laws of reflection is the most obvious.

From the "transmitted" side of the mica sheet there are certainly no fewer than thirty distinct beams apart from the intense primary beam which has passed through the crystal (0·33 mm. thick) without much absorption. The plane of the mica sheet was perpendicular to that of the photographic plate. In the reproduction given below, the intense black spot is produced by the transmitted primary beam, while beneath it is seen another circular patch due to the ordinary reflected beam.



The greatest photographic intensity occurs in those transmitted beams which have suffered the least deviation, the ordinary reflected pencil being feeble in comparison with some of them.

It will be evident that the transmitted pattern is analogous to that obtained by Messrs. Laue, Friedrich, and Knipping (Nature, November 14, 1912, p 306), using a pencil of X-rays falling normally on a crystal of zincblende. Repeating my experiments, using a normal pencil, a transmitted pattern is obtained similar to theirs.

Besides giving rise to numerous pencils in definite directions, the mica sheet exhibits the ordinary incident and emergent scattering. It is well known that this effect is small in the plane of the radiator. This is borne out in all the negatives which exhibit general fogging, except along a line which represents the line of intersection of the photographic plate by a plane containing the mica sheet. This line is represented in the diagram by the broken line. Similar results are obtained using rock salt and galena.

Since the photograph described above is unsuitable for reproduction by a half-tone block, I have been obliged here to substitute a diagrammatic copy for it.

H. B. Keene.

Physics Department, University of Birmingham, March 15.

The Presence of Protozoa in Soils.

Up to the present, so far as I am aware, the only method of demonstrating the presence of Protozoa in soils has been by cultures. This method, of course, leaves untouched the really important question as to what Protozoa are leading a trophic existence at any given time in a soil sample, since many of the forms found later on in cultures may be derived from cysts. In these circumstances I thought it might be of interest to direct attention to a method by which the presence of Protozoa in the trophic stage in the soils can be readily demonstrated, even though this method from a quantitative point of view probably gives low results.

A small quantity of the soil to be investigated is mixed, as soon as it is collected, with about an equal volume of picric acid. The mixture is then placed in a wide dish and carefully stirred, so that the organisms on the surface films between the soil particles are free. If the mixture is then allowed to stand for a time it will be found that most of the bacteria, diatoms and Protozoa that were present come up to the surface film. The coverslips, cut according to the method which I have previously described, can then be floated on the film, and then placed in tubes containing corrosive. These cover-slips can then be handled as though they were ordinary smears. The best method of staining seems to be to stain for some time in strong acid haemalum, followed by eosin. I have tried mixing the soil in the first instance with other fixatives in the place of picric acid, but have not obtained such good results. By this method perfectly clean preparations, showing large numbers of amœba and flagellates, have been obtained from a six weeks old bed, which had been used for growing seedling cauliflowers. These have been used to compare the active fauna of such a soil with the fauna derived from the same soil in cultures.

As might be expected, it has been found that the prevalence of any given Protozoon in the cultures is not an indication of its prevalence in the trophic stage in the soil, though by varying the methods of culture it has been found possible to cultivate all the Protozoa that have been found by the above method leading a trophic life in this soil at the date of fixation.

C. H. Martin.

The Hill, Abergavenny, March 19.

Jelly-fish of the Norquane River.

The discovery of a jelly-fish in the northern watershed of the Limpopo will be of some interest to zoologists.

During the new year holidays, while making zoological collections in the Bembezi district (thirty miles north-east of Bulawayo), I noticed some jelly-fishes in a pool of the Norquane River, a tributary of the fourth degree of the Limpopo.

With the scanty literature at my disposal, it is not possible at present to identify or determine it as a new species, but judging by the figures in Lankester's "Treatise on Zoology" and in the "Cambridge Natural History," and also by Mr. Moore's statement ("The Tanganyika Problem") that *Limnocnida tanganyikae* varies in size from that of a shilling to

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